Federal Energy Management Program

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

Compressed Air Assessment Basics

Housekeeping

- Please Mute your Telephone or Mic
  - Use Grab Bar or manual button on your handset
  - Do Not Use “HOLD”
- For better connectivity
  - Remove wireless devices from viewing area
  - Close unnecessary applications
- Training is being recorded
- Slides will be provided
- Course evaluation = 2 PDHs

Introduction: Department of Energy

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Federal Energy Management Program (FEMP) Headquarters Sponsor
  - Technology Deployment
  - Data Center Energy Efficiency
  - Labs21 (Laboratories for the 21st Century)
  - Water Efficiency
  - New Technologies
  - Sustainability

  - http://www1.eere.energy.gov/femp/index.html

The Office of Energy Efficiency and Renewable Energy (EERE) works to strengthen the United States' energy security, environmental quality, and economic vitality in public-private partnerships.

http://www.eere.energy.gov/

It supports this goal through:

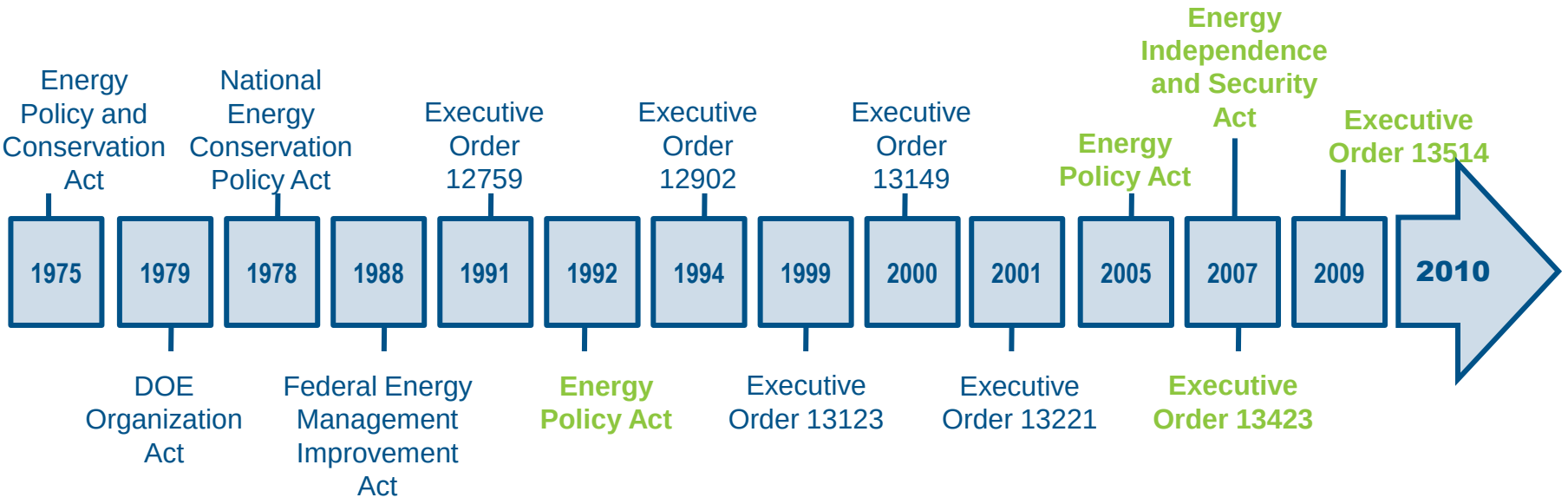
- Enhancing energy efficiency and productivity;
- Bringing clean, reliable and affordable energy technologies to the marketplace; and
- Making a difference in the everyday lives of Americans by enhancing their energy choices and their quality of life.

Program collaboration

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- Federal Energy Management Program
  - Technology Deployment Program
    - Technical Assistance
    - Training Opportunities
    - For More Information
      - » http://www1.eere.energy.gov/femp/program/industrial_facilities.html
      - » Thomas Wenning, wenningtj@ornl.gov , 865-241-8676
- Industrial Technologies Program
  - BestPractices
    - R&D for industrial sector energy efficiency technologies
    - Technical Publications
    - Software Tools
    - For More Information
      - » http://www1.eere.energy.gov/industry/bestpractices/index.html

Public Laws & Executive Orders

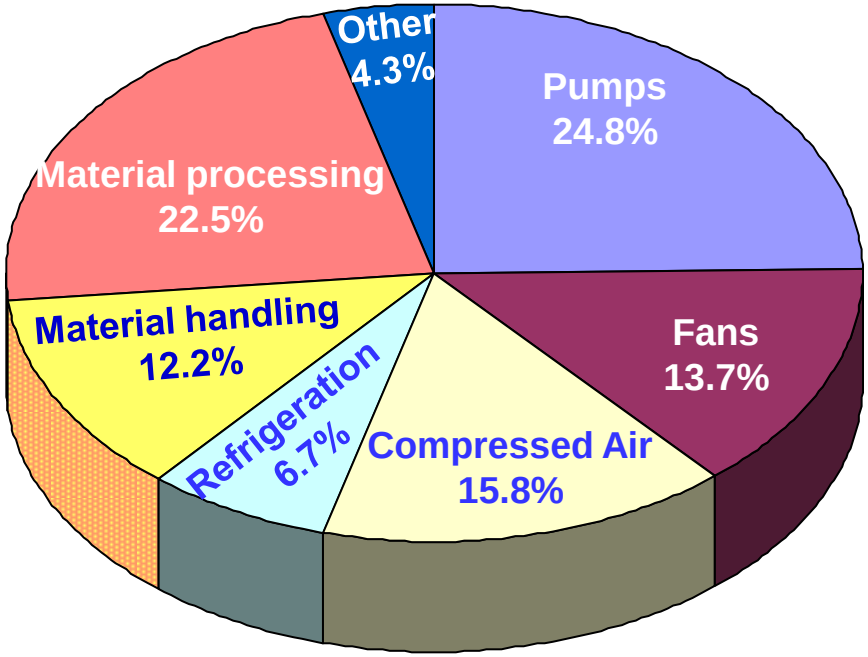


Facilitate the Federal Government's implementation of sound, cost-effective energy management & investment practices to enhance the nation's energy security & environmental stewardship

Stewardship is required and smart

- Industrial motor systems:
  - Are the *single largest electrical end use* category in the American economy
  - Account for 25% of U.S. electrical sales

- Over 60% of that electricity goes to fluid handling



http://www1.eere.energy.gov/femp/regulations/regulations.html

Today

- Look at how we get started on the path to savings
  - Major components of an assessment
  - A useful tool to help quantify potential savings
    - AirMaster+
    - LogTool

The Facilitator

- Tom Taranto – Data Power Services
  - Qualified AirMaster+ Compresesd Air Assessment Tool (AirMaster+) Specialist
  - Teaches 1-day end-user AirMaster+ Workshop
  - Co-instructs 3-day Qualified Specialist Workshop
  - Does plant assessments for the Save Energy Now program
  - Contact Information:
    - TomTar@aol.com
    - 315-635-1895

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FEMP

Federal Energy Management Program

Industrial Facilities Initiative

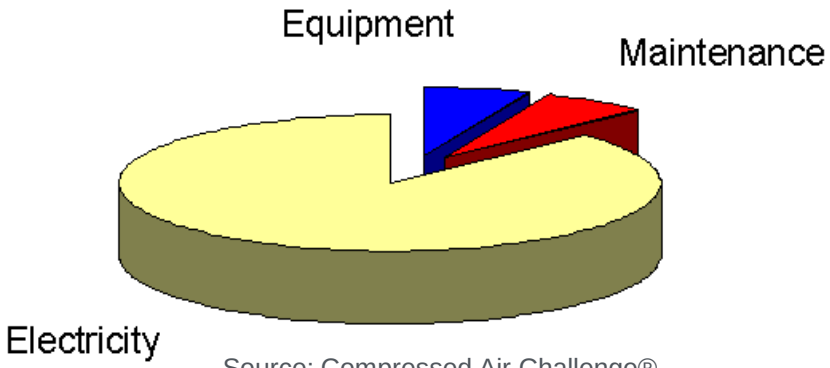
Compressed Air System Assessment Basics
Featuring the AIRMaster+ Software Tool

Technical Topics Agenda

- Overview – Why it's Important
- Planning for the Assessment
- Baseline Measurement
- Compressed Air Energy Opportunities
- Software Tool – LogTool
- Software Tool – AIRMaster+
- Case Study

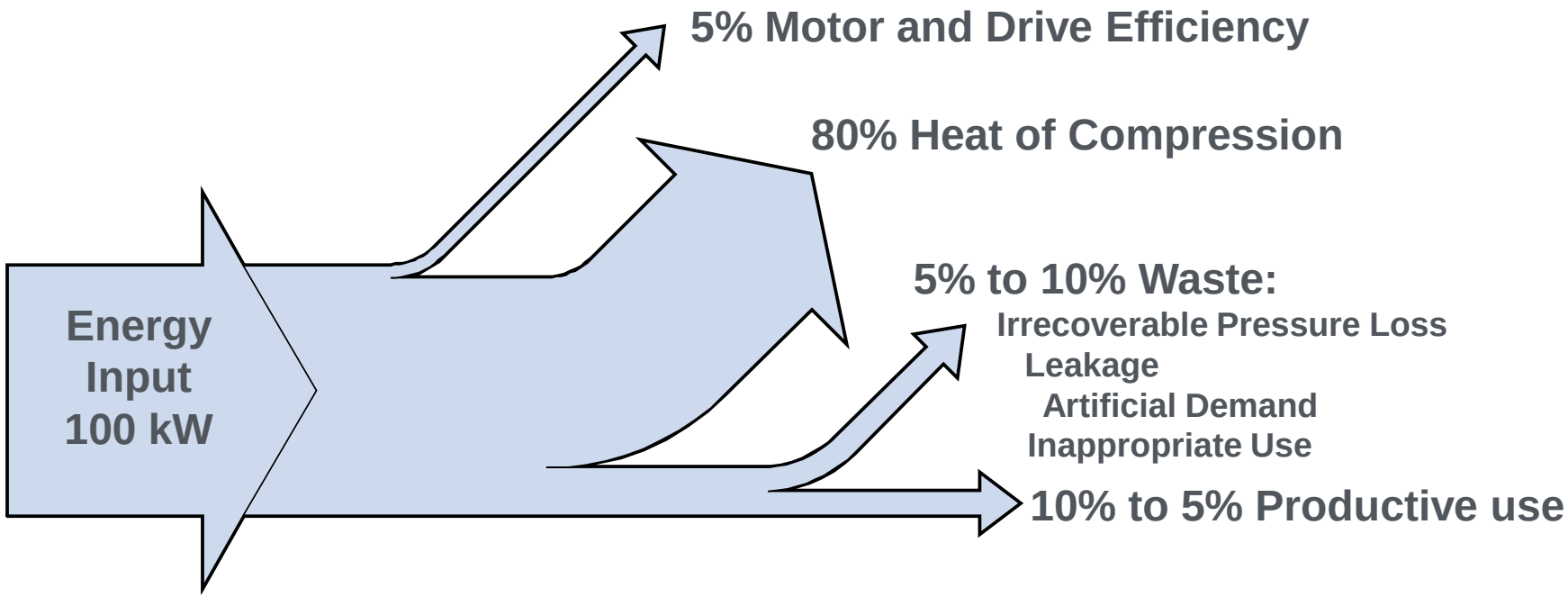
Why it's Important: Cost of Ownership

- Equipment cost and maintenance cost represent only a small part of the total cost of operating a compressed air system.
- Electrical cost usually exceeds 75% of the total operating expense.

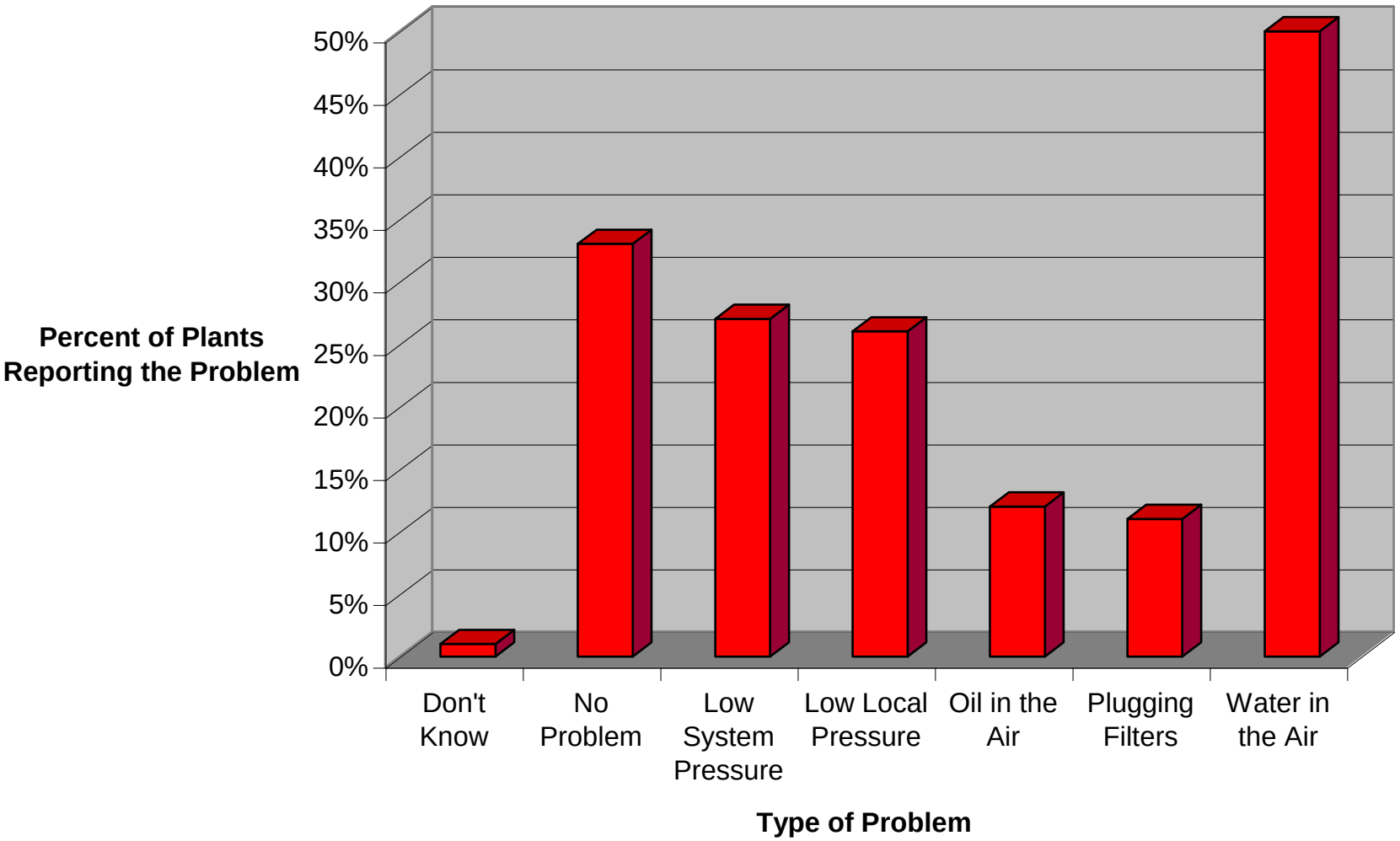


Source: Compressed Air Challenge®

Why it's Important: Energy Flow



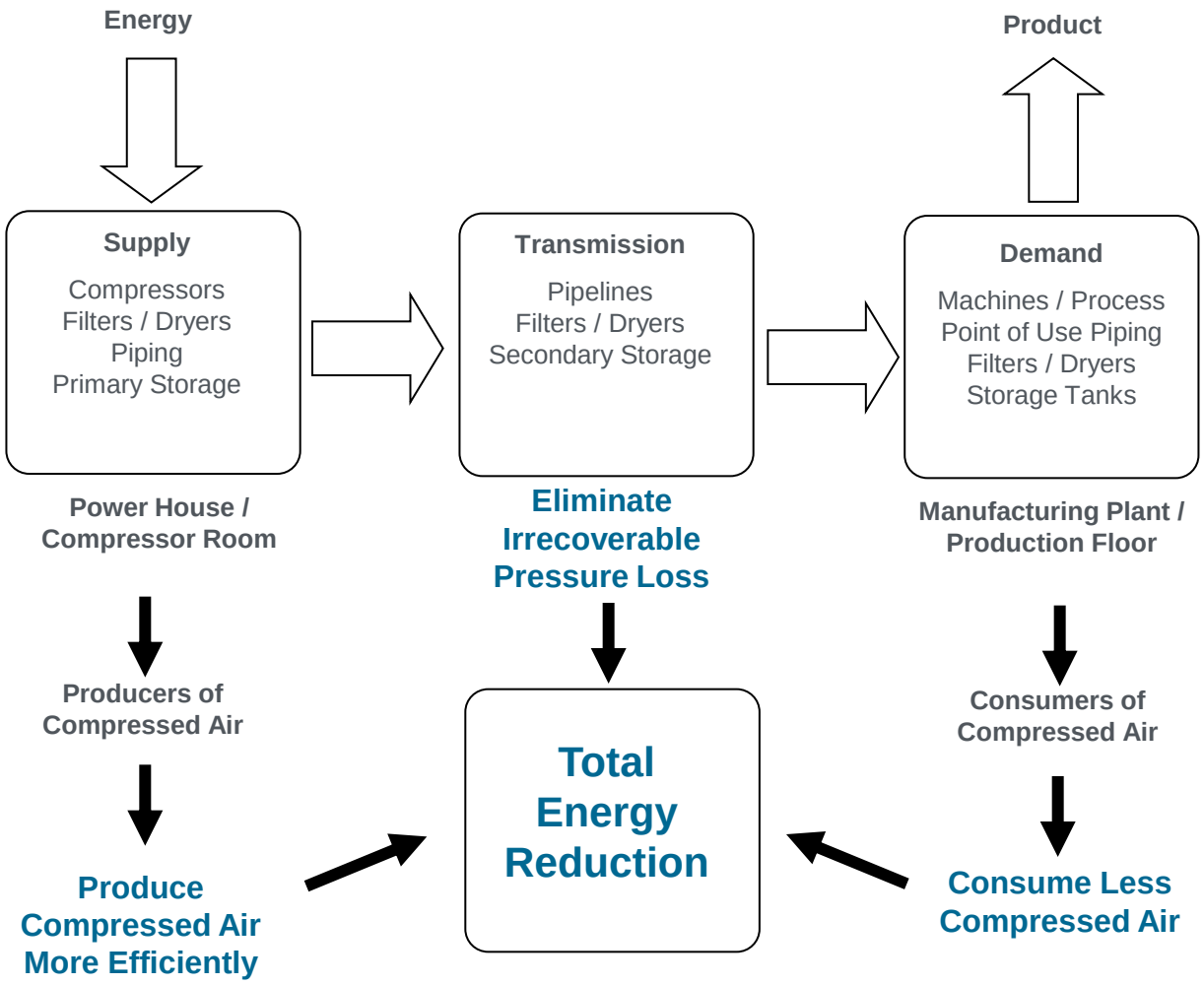
Why it's Important : Reported Air System Problems



Planning for the Assessment

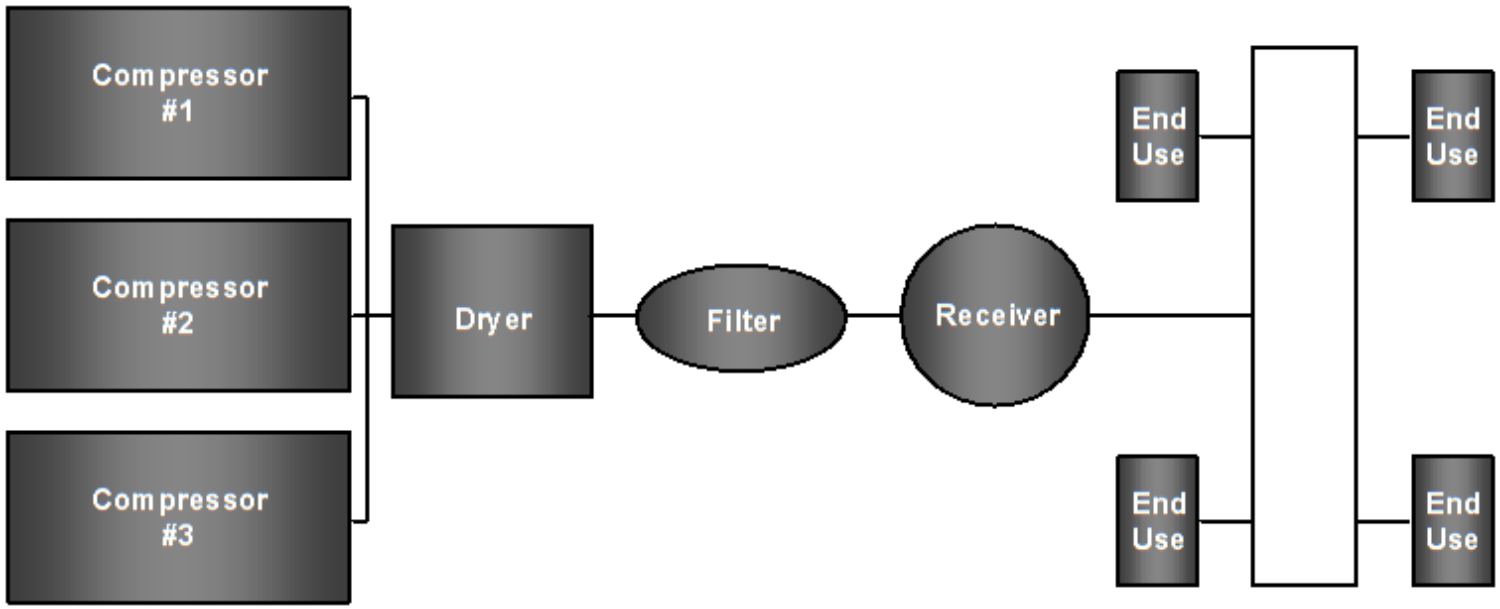
1. System Approach
2. Block Diagrams
3. Key Issues
4. Energy Costs/ Assessment Costs

Systems Approach
plant efficiency: energy >> product



Block Diagram

- Graphic representation of compressed air system and the relationship of individual components

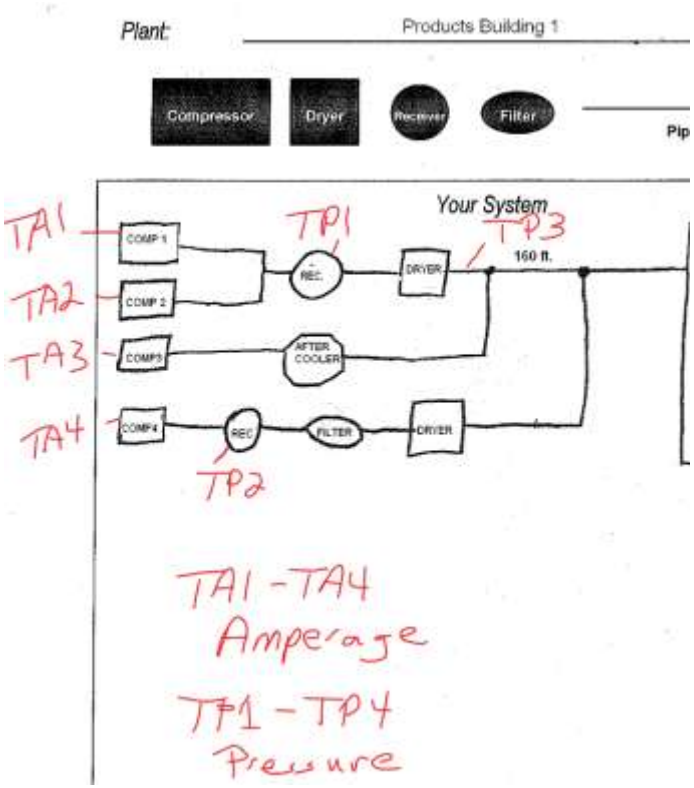


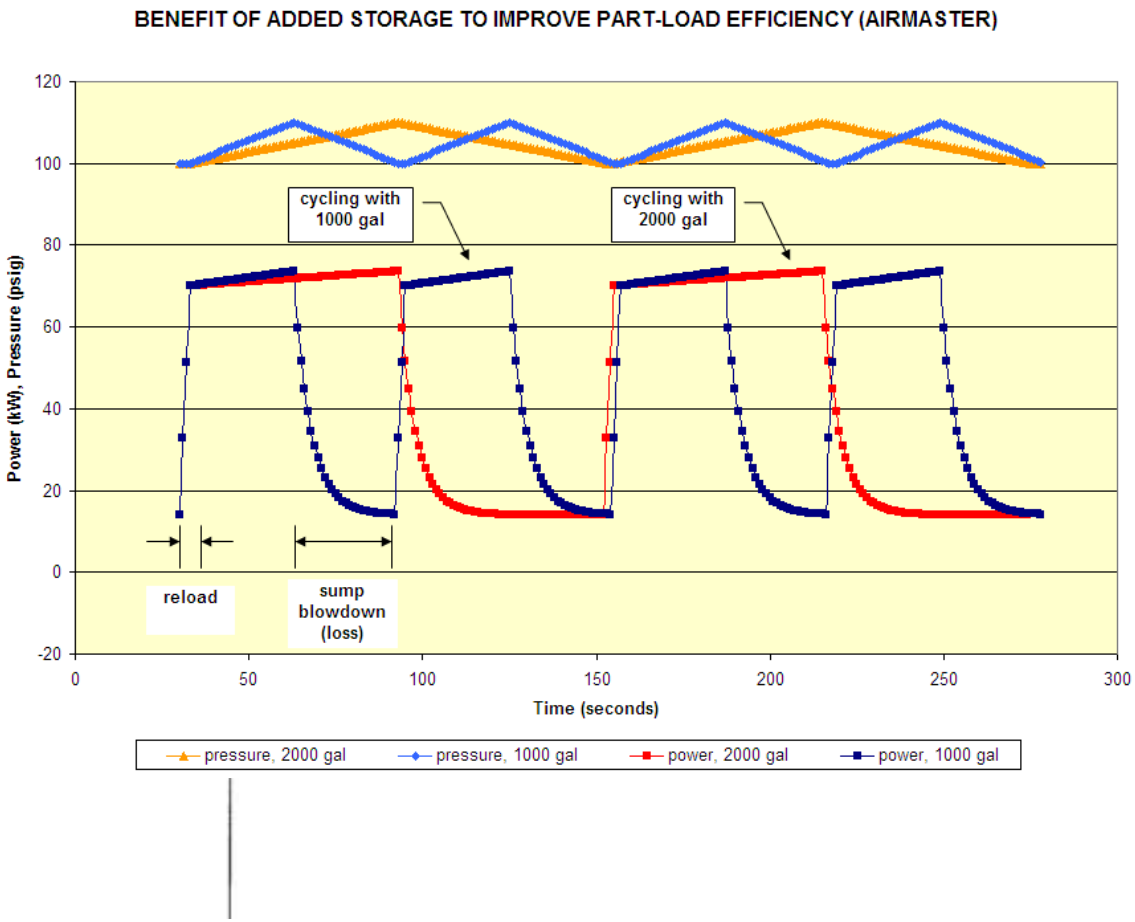
Key Issues

- Gather pre-assessment information
  - Block Diagrams
  - Compressor Information
    - Rating (flow & pressure), Horsepower, Operating Hours
  - Estimate of annual energy use
  - Review end use applications
    - Potentially inappropriate use of compressed air
    - Perceived high pressure applications
    - High volume intermittent applications
    - Largest compressed air energy uses
  - Compressed air related problems
    - Low air pressure
    - Water in the compressed air
    - Unreliable operation

Baseline Measurement

- Measurement Plan
- Identify Opportunities





Compressed Air Energy Opportunities

1. Produce Compressed Air More Efficiently
   - Control Strategy
2. Eliminate Irrecoverable Pressure Loss
   - Reducing System Pressure
   - Pressure Profile
3. Consume Less Compressed Air
   - Leakage,
   - Artificial Demand
   - Inappropriate Use

Control Strategies

Source: Compressed Air Challenge®

Pressure Profile

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Rules of Thumb for Relating Discharge Pressure to Energy Consumption

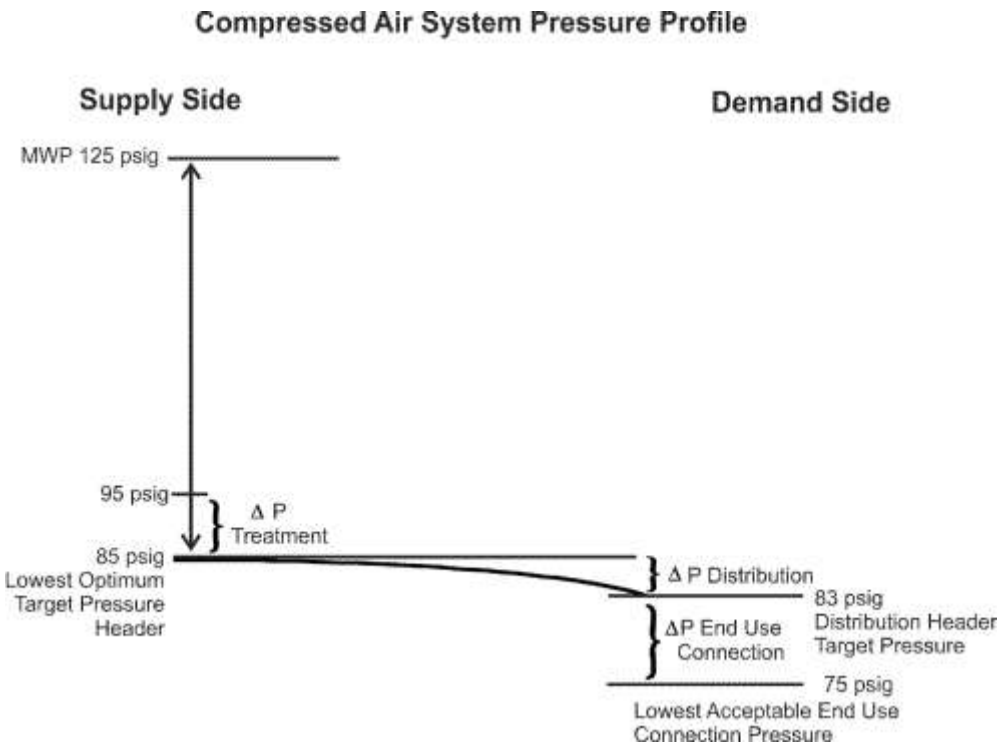
For systems in the 100 psig range, for every 2 psi increase in discharge pressure, energy consumption will increase by approximately 1 percent at full output flow (check performance curves for centrifugal and two-stage lubricant injected rotary screw compressors). There is also another penalty for higher-than-needed pressure. Raising the compressor discharge pressure increases the demand of every **unregulated usage, including leaks,** open blowing, etc.

Although it varies by plant, unregulated usage is commonly as high as 30-50% of air demand. For systems in the 100 psig range with 30%-50% unregulated usage, a 2 psi increase in header pressure will increase energy consumption by about another 0.6-1.0 percent, because of the additional unregulated air being consumed (in the worst-case scenario, the extra flow could cause another compressor to start).

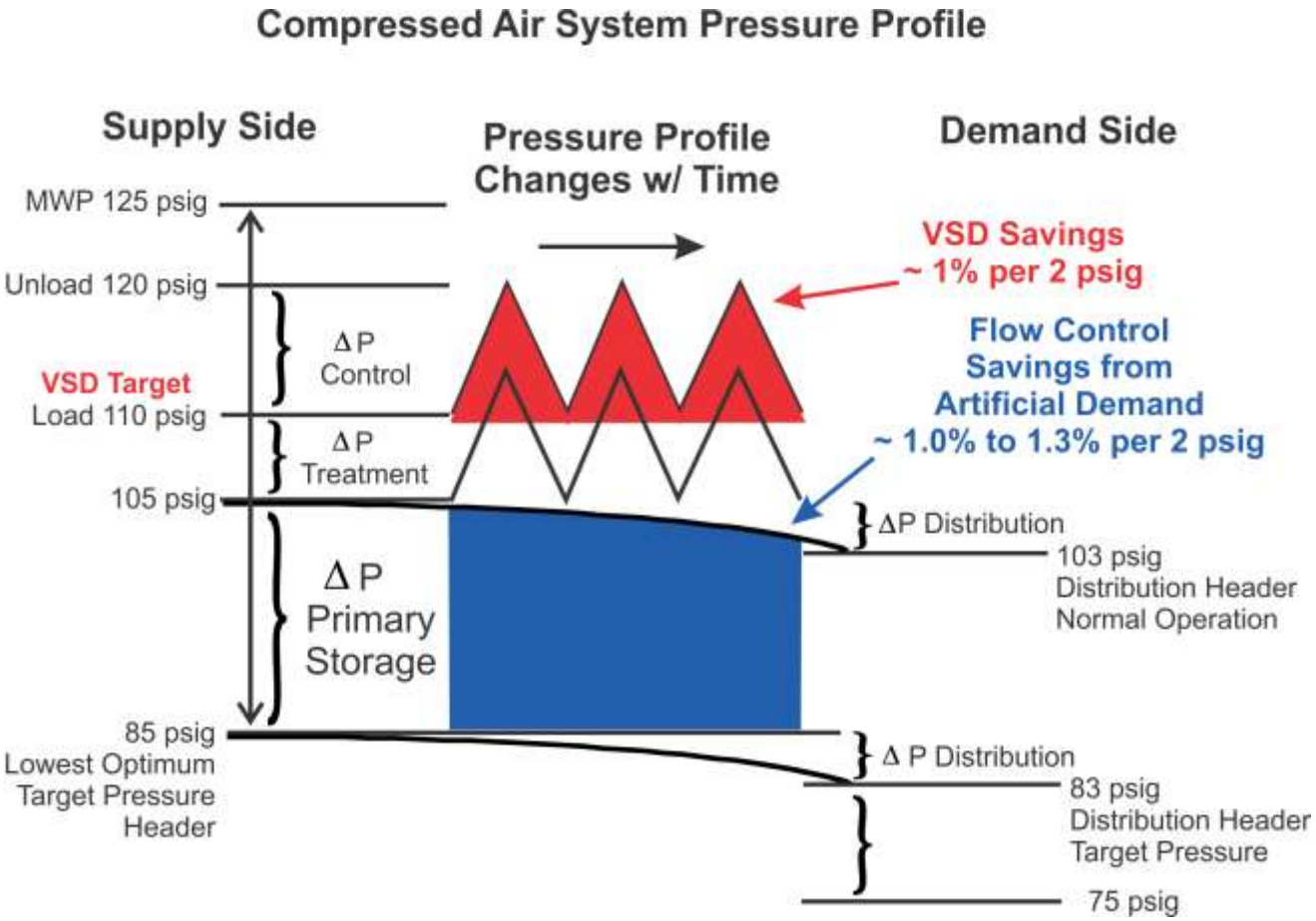
The combined effect results in a total increase in energy consumption of about 1.6 to 2 percent for every 2 psi increase in discharge pressure for a system in the 100 psig range with 30-50 unregulated usage.

Simple Pressure Profile

- Pressure profiles describe the system's operating pressure from the supply to end use applications.
- Pressure profiles are created by taking a group of pressure measurements at key points throughout the system.
- Key points to measure pressure might include, the compressor discharge, upstream and downstream of treatment equipment, in the distribution piping, and at selected end us applications.

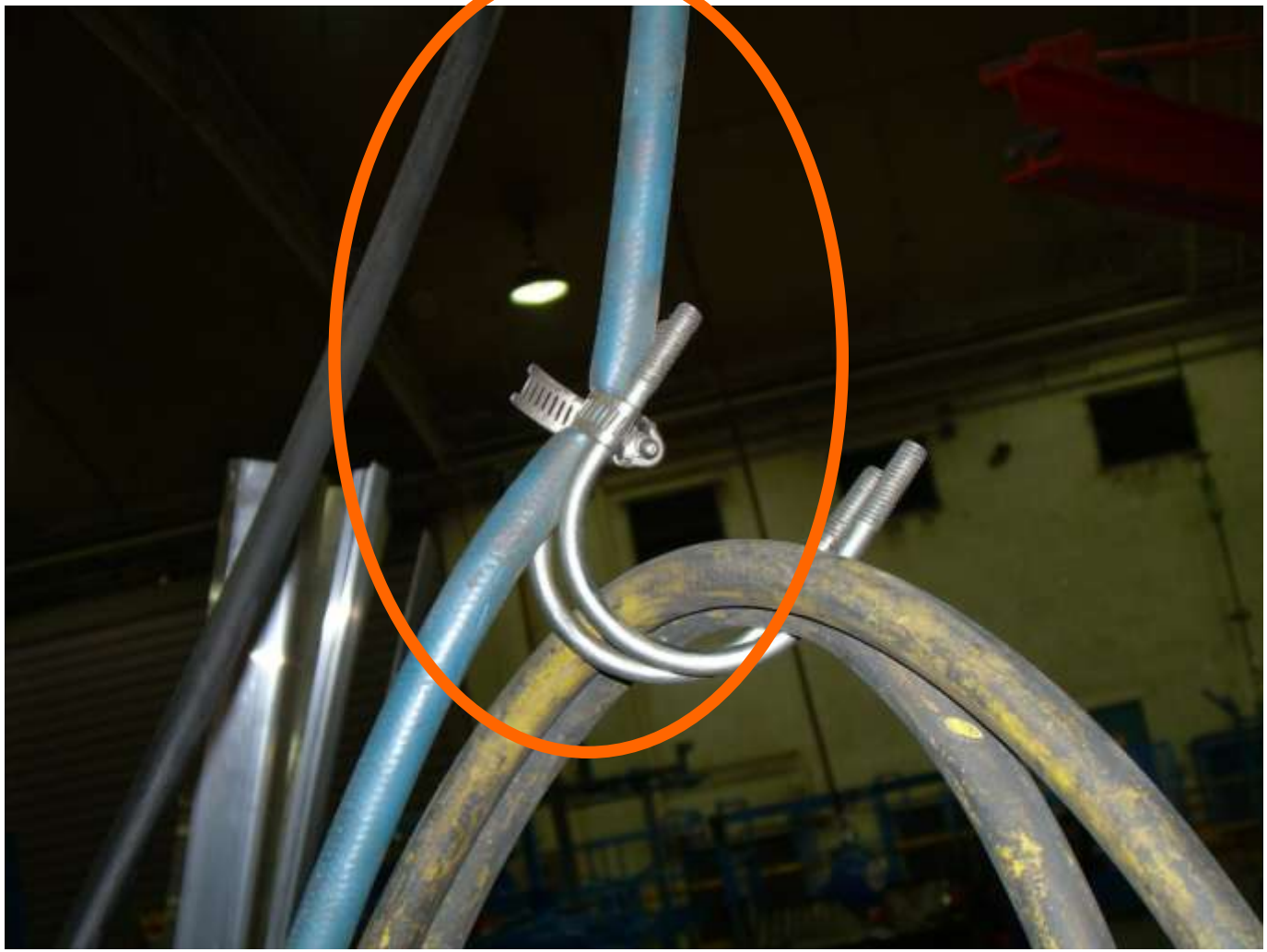


System Pressure Profile



The combined effect results in a total increase in energy consumption of about 1.6 to 2 percent for every 2 psi increase in discharge pressure for a system in the 100 psig range with 30-50 unregulated usage.

GOT PRESSURE ?



GOT HOSES ?

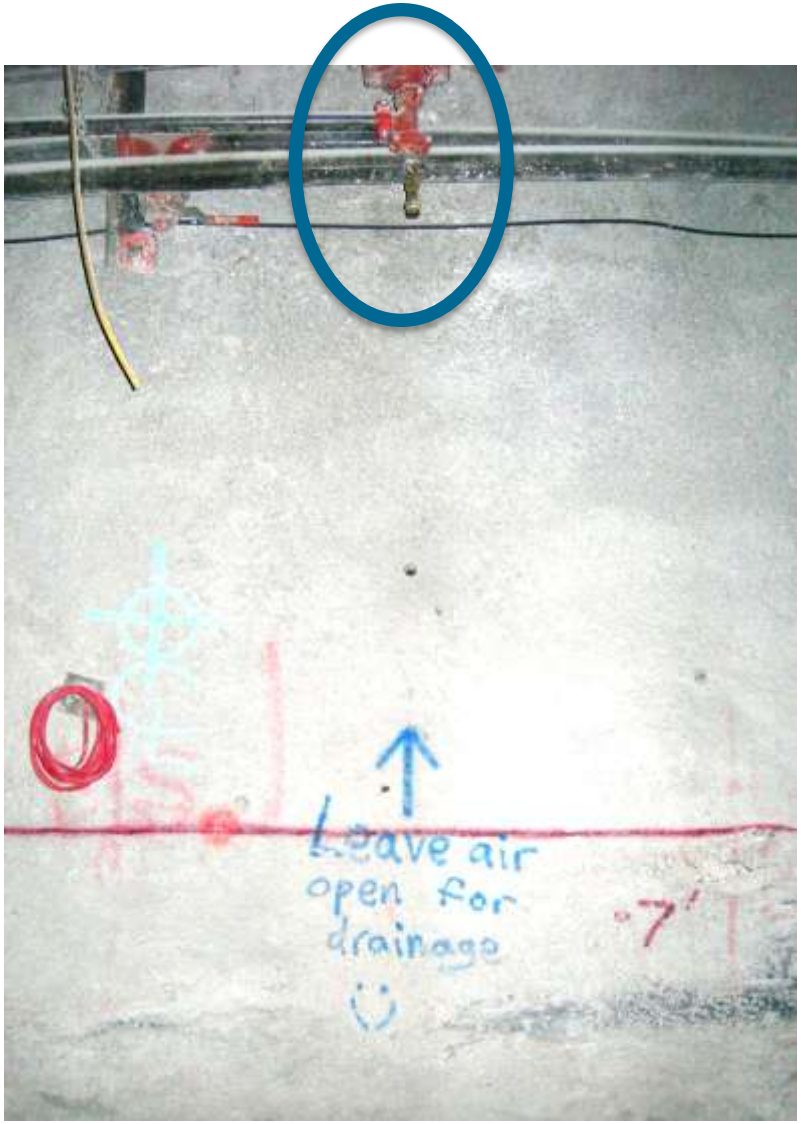
Compressed Air Waste

Leakage - Compressed air leaks exist in every compressed air system. It is not unusual for 25% to 35% of compressed air produced to be wasted to leakage. In some systems leakage is 50% or more of the air produced.

Artificial Demand - Artificial demand is the increased compressed air consumption of the system due to operating at higher than necessary operating pressure. Unregulated compressed air use; leakage, blowing applications, tools, air motors, pneumatic cylinders all consume more compressed airflow as system pressure increases. Air demand increases by 2% for each 2 psi increase.

Inappropriate Use of Compressed Air - Inappropriate use of compressed air is any use of compressed air that is wasteful; or use of compressed air where there is an alternative, more efficient, method or energy source that can be used to accomplish the production task.

Condensate Drainage Wastes Compressed Air



Potentially Inappropriate Use of Compressed Air

- Personnel Cleaning Station w/ Low Pressure Blower
  - Replaces compressed air hose previously used

- Air motors driving ink pumps
  - Latex ink no longer requires explosion proof construction

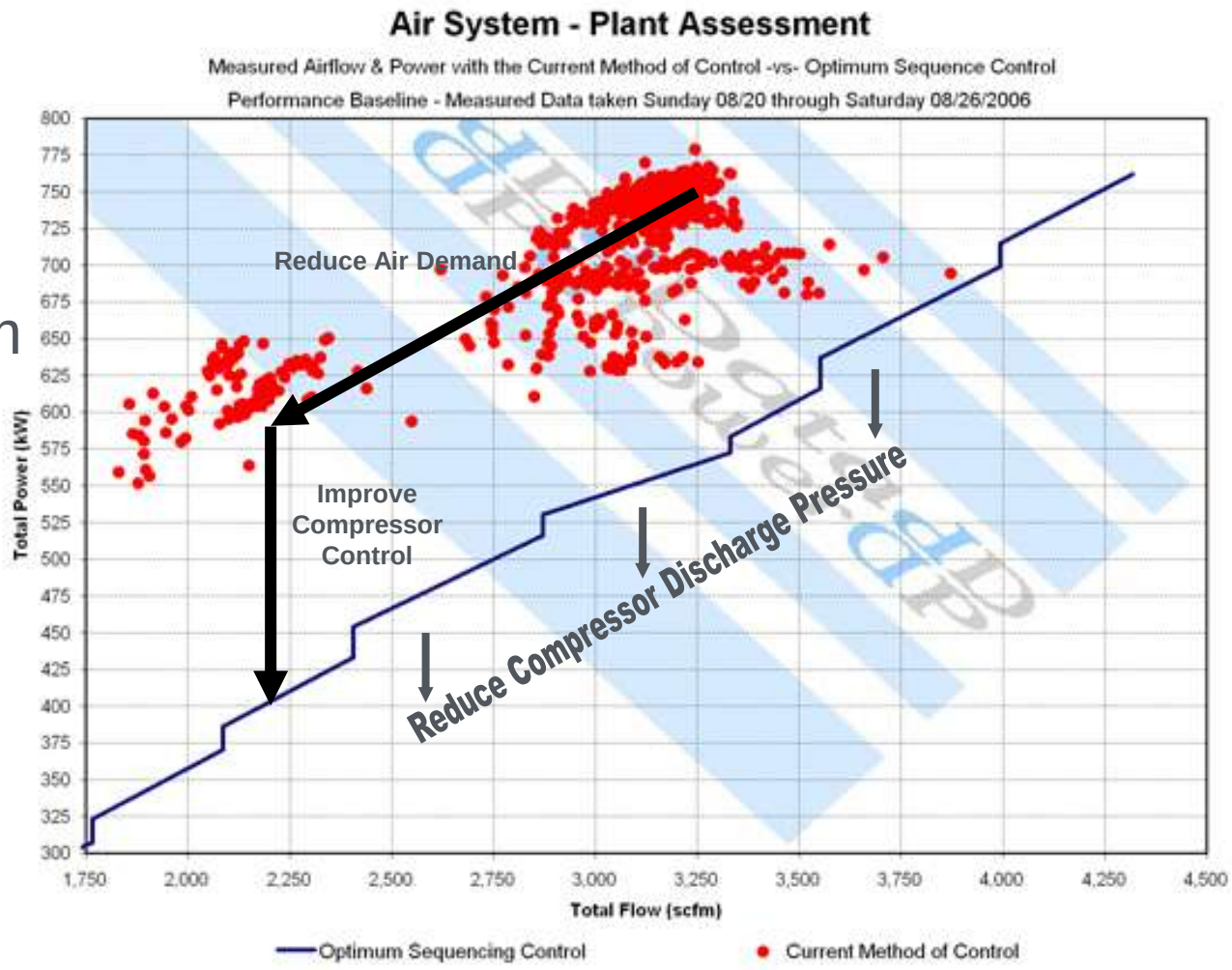
Potentially Inappropriate Use of Compressed Air

- Lime Tank Sparging w/ Compressed Air
  - Replace with a Low Pressure blower

- HP Blowing Tubes –vs – LP Blower
  - Reduction of Eye Injuries from Flying Debris

Look from the System Level Approach

- Improve Compressor Control
- Reduce System Pressure
- Reduce Air Demand



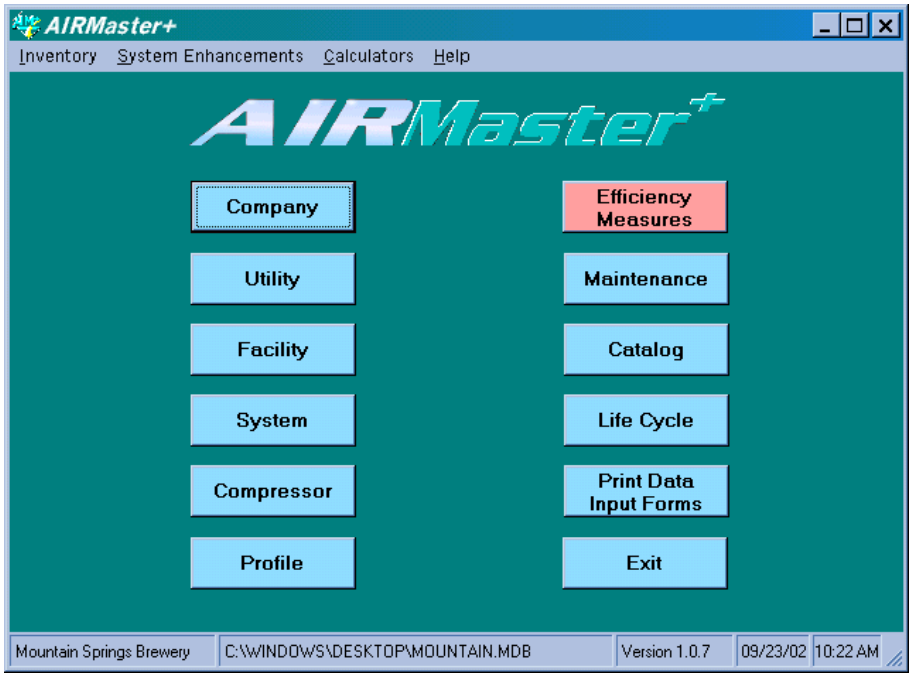
Quantifying Opportunities – Tools to Help

- Software Tool – AIRMaster+
  - Baseline Measurement & Annual energy use
  - EEM's (energy efficiency measures) and savings
- Software Tool – LogTool
  - Charting trend performance
  - Assess dynamics, and Compressor Control Response
  - Daily System Profiles Define Day Types

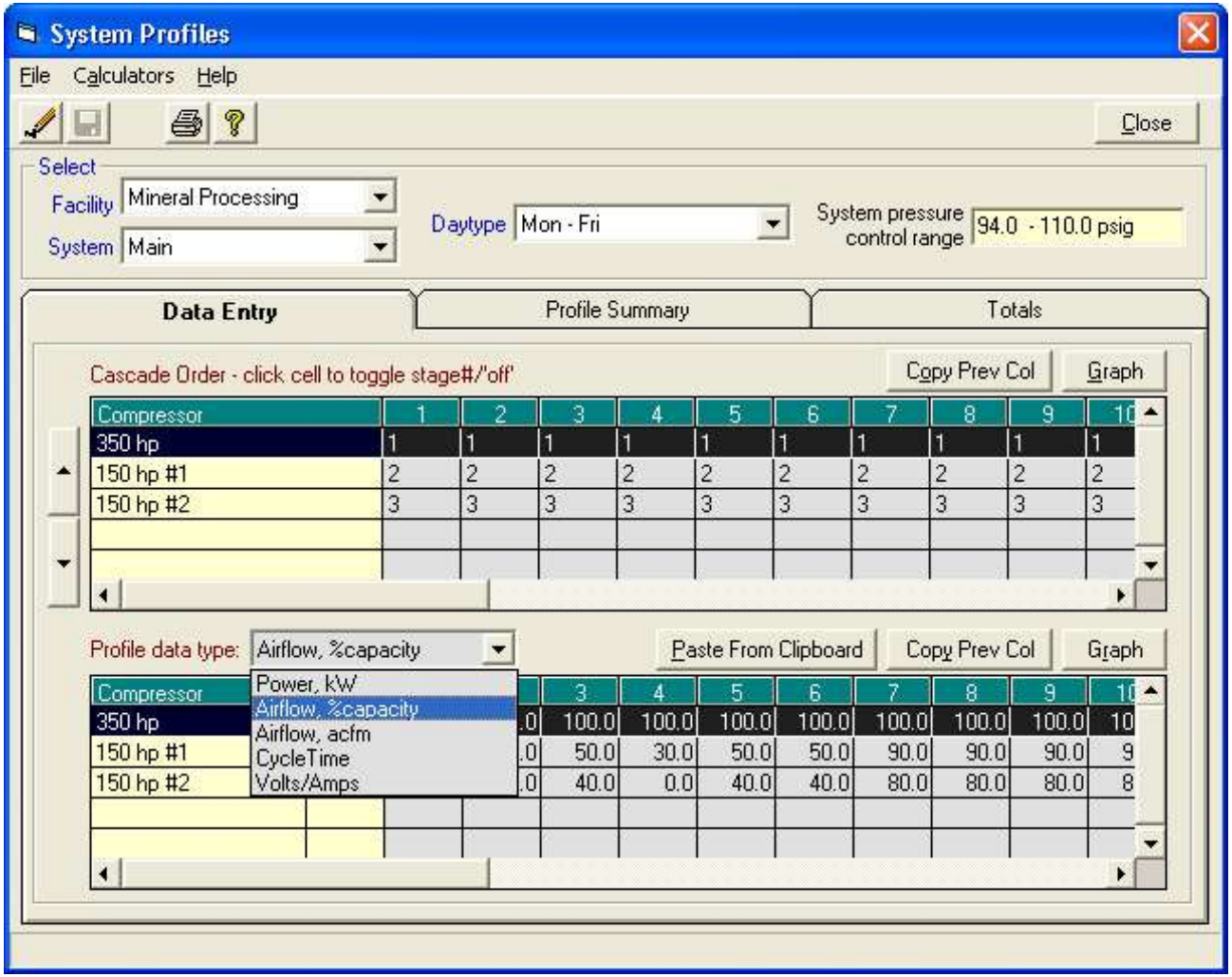
AIRMaster+

AIRMaster+ a Windows based software tool used to model and analyze industrial compressed air systems:

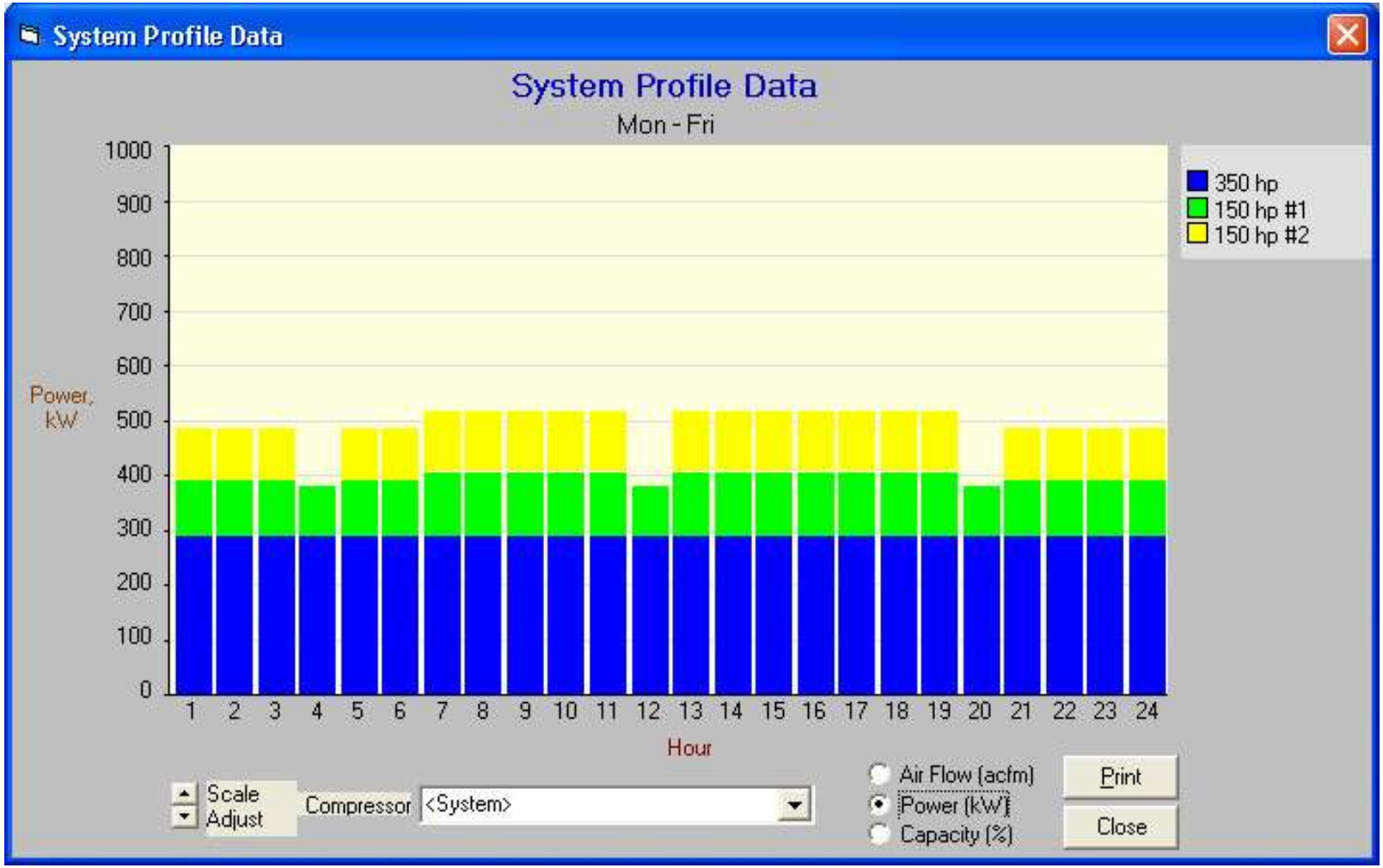
- Measure / Calculate Annual Baseline Energy & Cost
- Input 24-hour metered airflow or power data
- Assign electrical utility energy schedules
- Simulate compressed air system operation
- Model system operation at various loads
- Estimate Savings of Energy Efficiency Measures
- Is not a substitute for an experienced auditor!



AIRMaster+
System Profile – Data

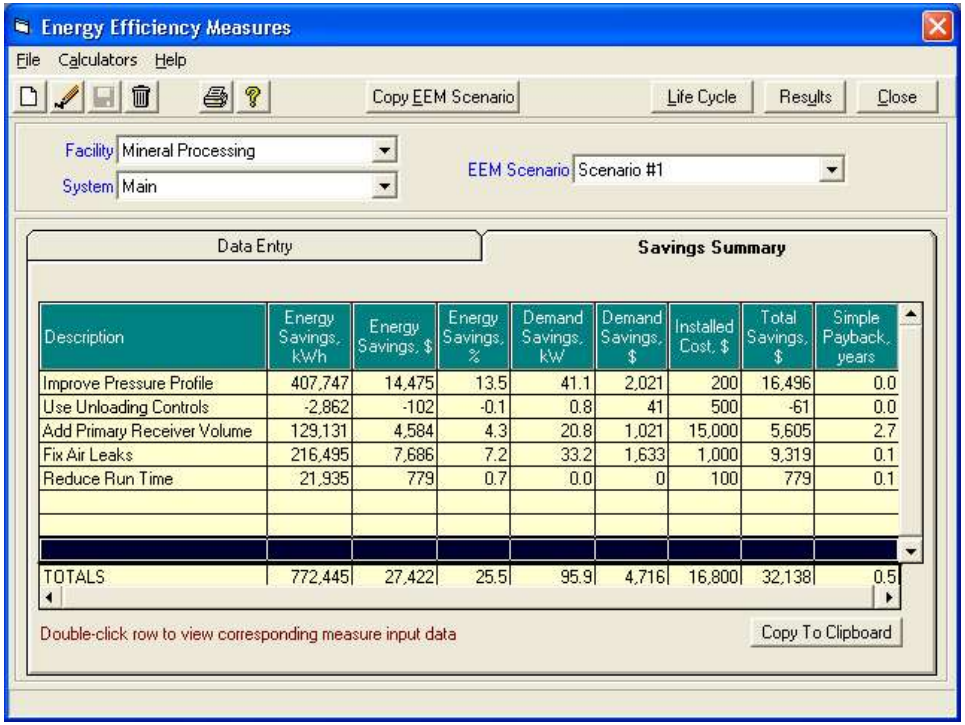


AIRMaster+
System Profile – Power (kW)



AIRMaster+ Energy Efficiency Measures

1. Reduce Air Leaks
2. Improve End Use Efficiency
3. Reduce System Air Pressure
4. Use Unloading ControlsAdjust Cascading Set Points
5. Use Automatic Sequencer
6. Reduce Run Time
7. Add Primary Receiver Volume



LogTool v2

- LogTool is a public domain tool available from SBW Consulting, Inc.
  - Import data from different types of data loggers
  - Display trend plots with one or two Y axes
  - assist in the analysis of compressed system performance measurements
  - Display DayType plots
  - a companion tool for AIRMaster+, also available from the Compressed Air Challenge

LogTool v2 – Import Data

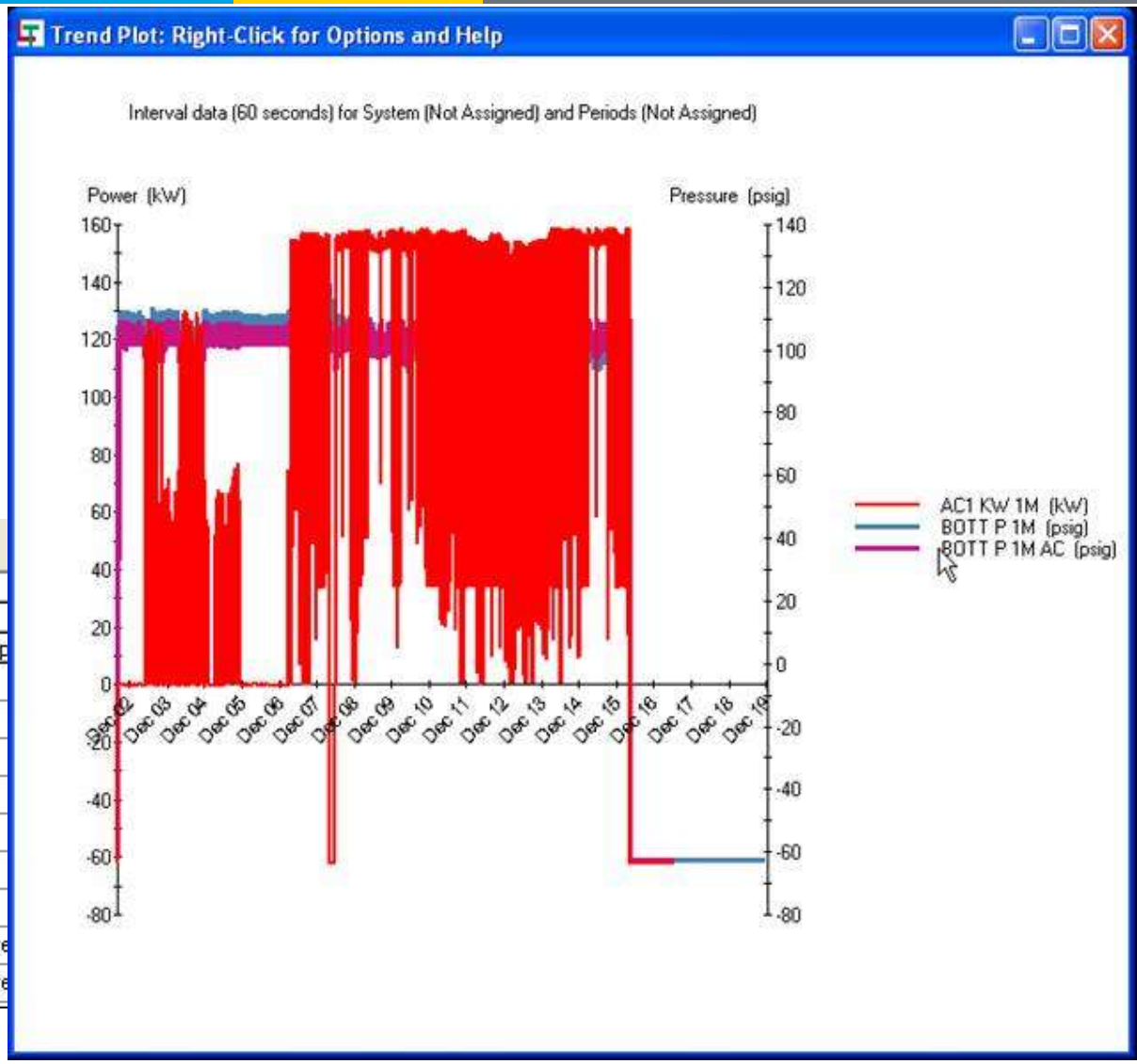
- The import screen gives you tools to import data from different types of data loggers

LogTool v2 Trend Plot

- Select Channels to Plot

Trend | Scatter | DayType

	Trend		Scatter		DayType		
View	Y1	Y2	X	Y	Include	Name	Typ
Data	☐	☐	☐	☐	☐	AC 1 KW 1 M	Power
Data	☑	☐	☐	☐	☐	AC1 KW 1M	Power
Data	☐	☐	☐	☐	☐	AC1 KW 3S	Power
Data	☐	☐	☐	☐	☐	AC1 KW 3S2	Power
Data	☐	☐	☐	☐	☐	AC2 KW 1M	Power
Data	☐	☐	☐	☐	☐	AC2 KW 3S	Power
Data	☐	☐	☐	☐	☐	AC2 KW 3S2	Power
Data	☐	☑	☐	☐	☐	BOTT P 1M	Pressure
Data	☐	☑	☐	☐	☐	BOTT P 1M AC	Pressure



LogTool v2 Trend Plot

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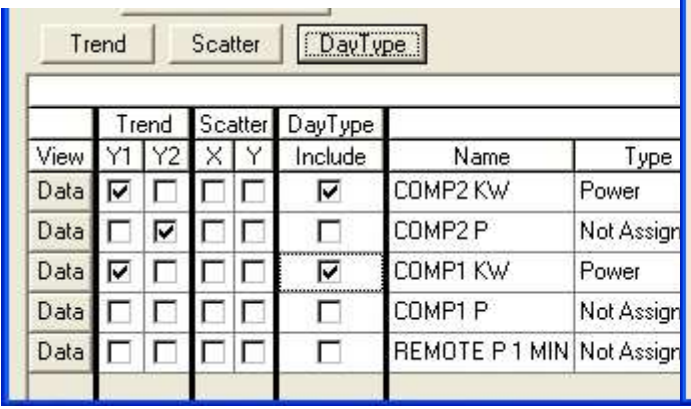
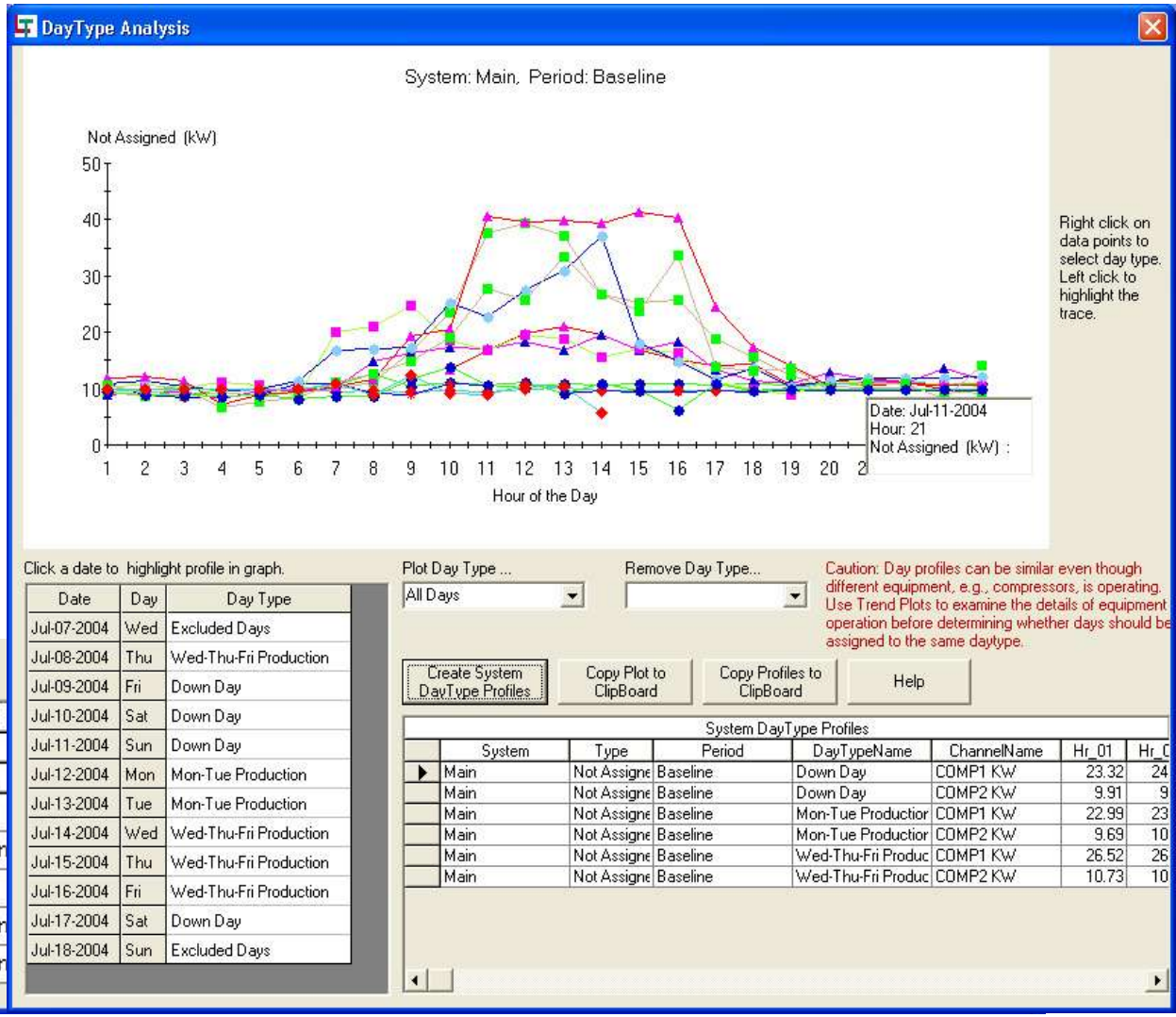
- Create Day Types for AIRMaster+ System Profile





LogTool v2
Paste DayTypes into Excel

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- View DayType Profiles in Excel

Microsoft Excel - DayType-ExcelSample.xls [Read-Only]

File Edit View Insert Format Tools Data Window ACT! Help Adobe PDF

Type a question for help

Arial 10 100%

D27

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	System	Type	Period	DayTypeName	ChannelName	Hr_01	Hr_02	Hr_03	Hr_04	Hr_05	Hr_06	Hr_07	Hr_08	Hr_09	Hr_10	Hr_11
2	Main	Not Assigr	Baseline	Down Day	COMP1 KW	23.31883	24.38368	23.99265	24.65419	23.7827	23.71069	24.28172	24.15927	25.39152	23.63532	23.9606
3	Main	Not Assigr	Baseline	Down Day	COMP2 KW	9.910972	9.341657	9.070322	9.302085	9.140594	9.738995	9.929728	9.99265	10.0878	11.38923	10.3626
4	Main	Not Assigr	Baseline	Mon-Tue Production	COMP1 KW	22.99389	23.60305	22.91625	22.05635	22.2651	23.15486	37.79541	42.5151	46.79852	47.95091	48.1047
5	Main	Not Assigr	Baseline	Mon-Tue Production	COMP2 KW	9.685127	10.14379	9.830324	9.53877	10.17374	9.15433	15.1418	17.93814	20.51559	17.90414	16.9320
6	Main	Not Assigr	Baseline	Wed-Thu-Fri Production	COMP1 KW	26.51718	26.63203	27.18745	26.84604	26.56435	25.37759	39.44926	43.28663	45.11143	46.40184	44.5422
7	Main	Not Assigr	Baseline	Wed-Thu-Fri Production	COMP2 KW	10.73021	10.35054	10.04517	8.220376	8.71347	9.667829	12.07147	13.08926	17.01233	22.11389	32.2138
8																
9																
10																
11	Date	Day	Day Type													
12	Jul-07-200	Wed	Excluded Days													
13	Jul-08-200	Thu	Wed-Thu-Fri Production													
14	Jul-09-200	Fri	Down Day													
15	Jul-10-200	Sat	Down Day													
16	Jul-11-200	Sun	Down Day													
17	Jul-12-200	Mon	Mon-Tue Production													
18	Jul-13-200	Tue	Mon-Tue Production													
19	Jul-14-200	Wed	Wed-Thu-Fri Production													
20	Jul-15-200	Thu	Wed-Thu-Fri Production													
21	Jul-16-200	Fri	Wed-Thu-Fri Production													
22	Jul-17-200	Sat	Down Day													
23	Jul-18-200	Sun	Excluded Days													
24																

Sheet1 Sheet2 Sheet3

Case Study – Live Demo

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We will step through:

1. Pre-assessment info
   - Plant Background
   - System/Plant Layout
   - System Issues
2. Demo of AirMaster+
3. Demo of LogTool v2

Note: Case demo is based on a real plant assessment

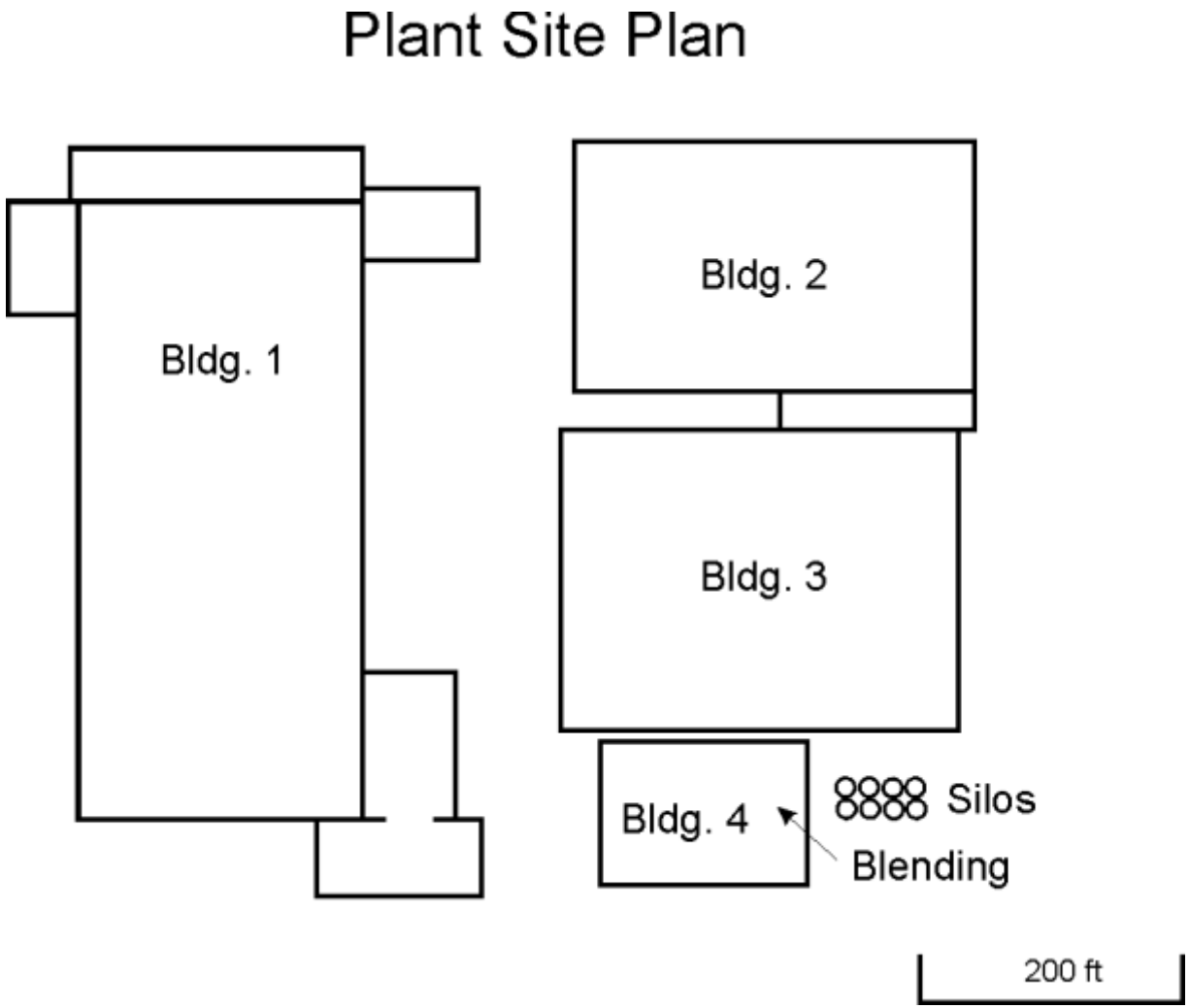
Case Study: Plant Background Information

- The plant produces cutting edge products made from synthetic materials that add functional advantage when compared to traditional materials.
- The plant operates a highly automated manufacturing process; from the custom blending of resins, to extruding and compression molding sheets, to finishing and loading operations.
- Products include highly engineered building materials using custom, proprietary, synthetic blends and user focused fabrication operations.
- A streamlined and efficient manufacturing process permits flexible expansion to meet growing customer demands.
- Present production operations at 40% of capacity.
- Four production buildings
- Eight air compressors supply three separate systems

Case Study: System Approach

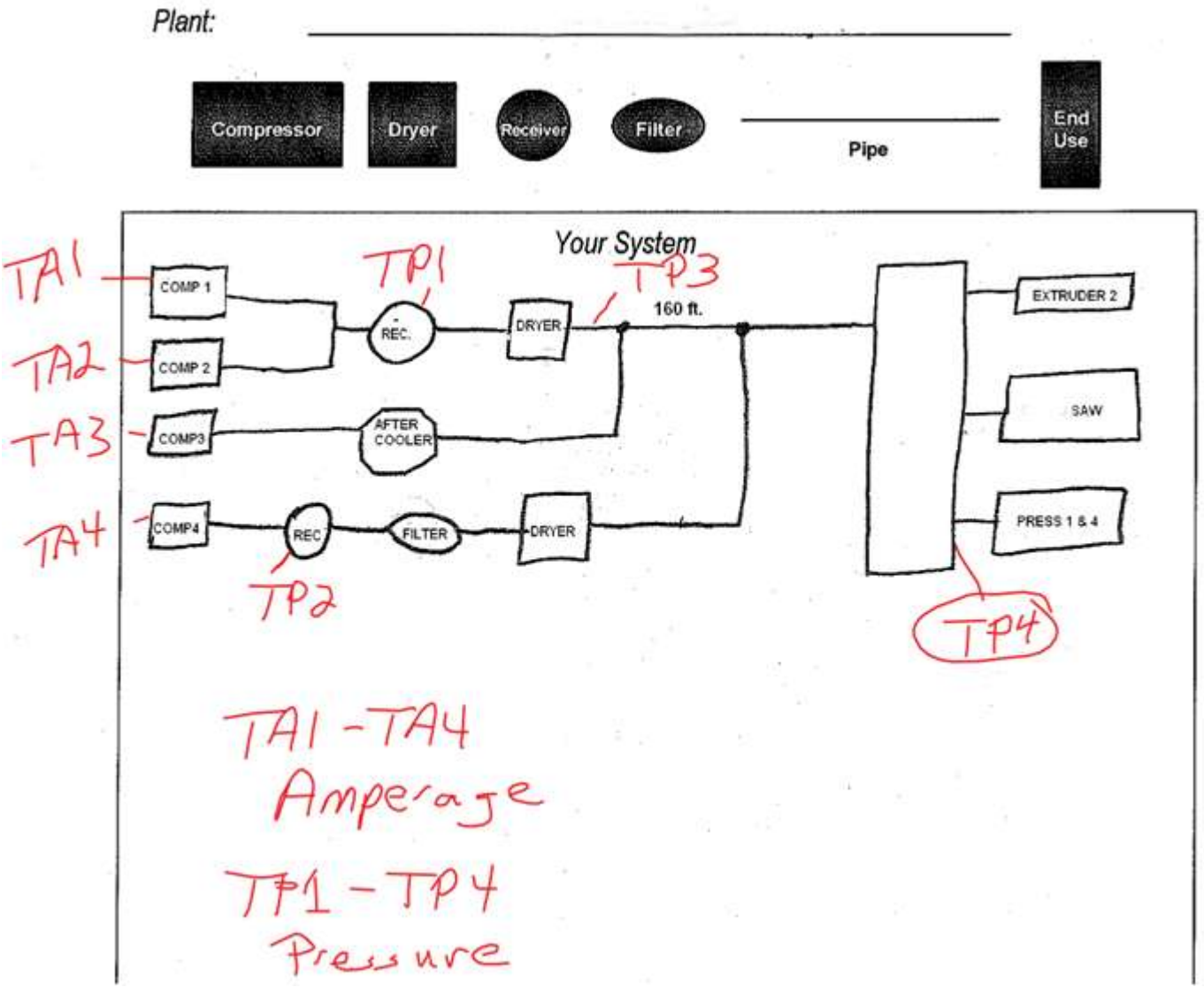
- Systems engineering focuses on defining stakeholders' needs and required system functionality early in the development cycle, documenting system requirements, and then proceeding with system design while considering the entire system. From energy input to air compressors to work performed in the production process.
  - Understand compressed air point of use as it supports critical plant production functions.
  - Correct existing poor performing applications and those that upset system operation.
  - Eliminate wasteful practices, leaks, artificial demand, and inappropriate use.
  - Create and maintain an energy balance between supply and demand.
  - Optimize compressed air energy storage and air compressor control.

Case Study: Plant Wide Site Plan



Case Study: Building 1 Block Diagram

- Simple Diagram
- Major Components
- Significant End Use Applications
- TA = Test Amperage
- TP = Test Pressure



Case Study: Key Issues Building 1

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Compressed Air System Assessment
Information from Facility Specialists (Appendix. I. 2c. 1-5)

Comment on overall system operation, supply pressure, reliability, air quality, etc.

Overall Operation: The compressors are old and worn. one 25 HP compressor is enough to run the presses and saw. When extruder 2 is started the 60 HP or 75 HP compressor needs to run. The air quality is fair. There has been moisture collecting in the unused air lines.

Describe routine operation of the compressed air related equipment that you work with.

Normal Operation: Normally the smallest air compressor that can run production is operated. the larger compressors are started based on demand.

For the compressed air related equipment that you work with, what problems exist; how often does it happen? What is the impact on energy efficiency, performance, and reliability?

Problems: Oil leaks on the old compressors have been the main problem in this building.

How can the compressed air system best support production operations? Please identify specific operations, or pieces of equipment that are of concern.

Supporting Production: There is little production in this building. Press 1 & 4 run Monday to Thursday and the saw is only run on 2 nd shift Monday to Friday. Extruder 2 runs only a few times a year. The GA 230 compressor should be replaced and new dedicated air lines run to the existing equipment.

Have there been problems in the past? What has been done to deal with the problems?

Historical Problems: Yes. There was a 125 HP compressor in use that was too large for the existing equipment on was short cycling causing excessive wear over heating and oil leaks. It was changed out for the 75 HP compressor.

Resources for More Information

- Visit the DOE BestPractices Web site:
  - www.eere.energy.gov/industry/bestpractices/
- Training Information & Calendar:
  - www.eere.energy.gov/industry/bestpractices/training_compressed_air.html
  - www.eere.energy.gov/industry/bestpractices/events_calendar.asp
- Download AIRMaster+ & LogTool:
  - www.eere.energy.gov/industry/bestpractices/software_airmaster.html
- Become a Qualified Specialist:
  - www.eere.energy.gov/industry/bestpractices/qualified_specialists/

FEMP's GHG Emissions

- Inventory and Manage Greenhouse Gases
  - http://www1.eere.energy.gov/femp/program/greenhousegases.html
  - Assistance
    - Federal Requirements
    - Guidance
    - EPA's Climate Leaders
    - Greenhouse Gas Protocol Initiative
- Federal Greenhouse Gas Accounting and Reporting - On Demand Training
  - http://apps1.eere.energy.gov/femp/training/course_detail_ondemand.cfm/CourseId=14

EPA's Simplified GHG Emissions Calculator

EPA Climate Leaders Simplified GHG Emissions Calculator (SGEC) Version 2.9

This calculator is designed as a simplified calculation tool to help organizations in estimating their greenhouse gas (GHG) emissions for reporting to the EPA's Climate Leaders program. All methodologies and default values provided are based on the most current Climate Leaders Greenhouse Gas Inventory Protocol guidance. The calculator will determine the direct and indirect emissions from all sources at a company when activity data is entered into the various sections of the workbook.

Tool Instructions:

(A) Click on the grey boxes below to go to the appropriate Tool Sheet.
(B) Enter data in Tool Sheet in ORANGE cells only. Final GHG emissions will be provided in CO_2 equivalent emissions in BLUE or GREEN cells. If data is not known or applicable, leave default value (blank, zero or other) in cell.
(C) Enter data in appropriate units, if needed convert units prior to entering into tool.
(D) Guidance for each calculation method is provided in the references at bottom of each sheet.

Tool Sheets:

Direct 1.0	Direct Emissions from Stationary Combustion Sources - Traditional Sources
Direct 2.0	Direct Emissions from Mobile Sources
Direct 3.0	Direct Emissions from Refrigeration and Air Conditioning Equipment
Direct 4.0	Direct Emissions from Fire Suppression Equipment
Direct 5.0	Direct Emissions from Stationary Combustion Sources - Gas Waste Streams
Indirect 1.0	Indirect Emissions from Purchase of Electricity
Indirect 2.0	Indirect Emissions from Purchase of Steam
Optional 1.0	Optional Emissions from Business Travel
Optional 2.0	Optional Emissions from Employee Commuting
Optional 3.0	Optional Emissions from Product Transport
Conversion Factors	Useful Conversion Factors

EPA's Carbon Footprint
http://www.epa.gov/climateleaders/smallbiz/footprint.html

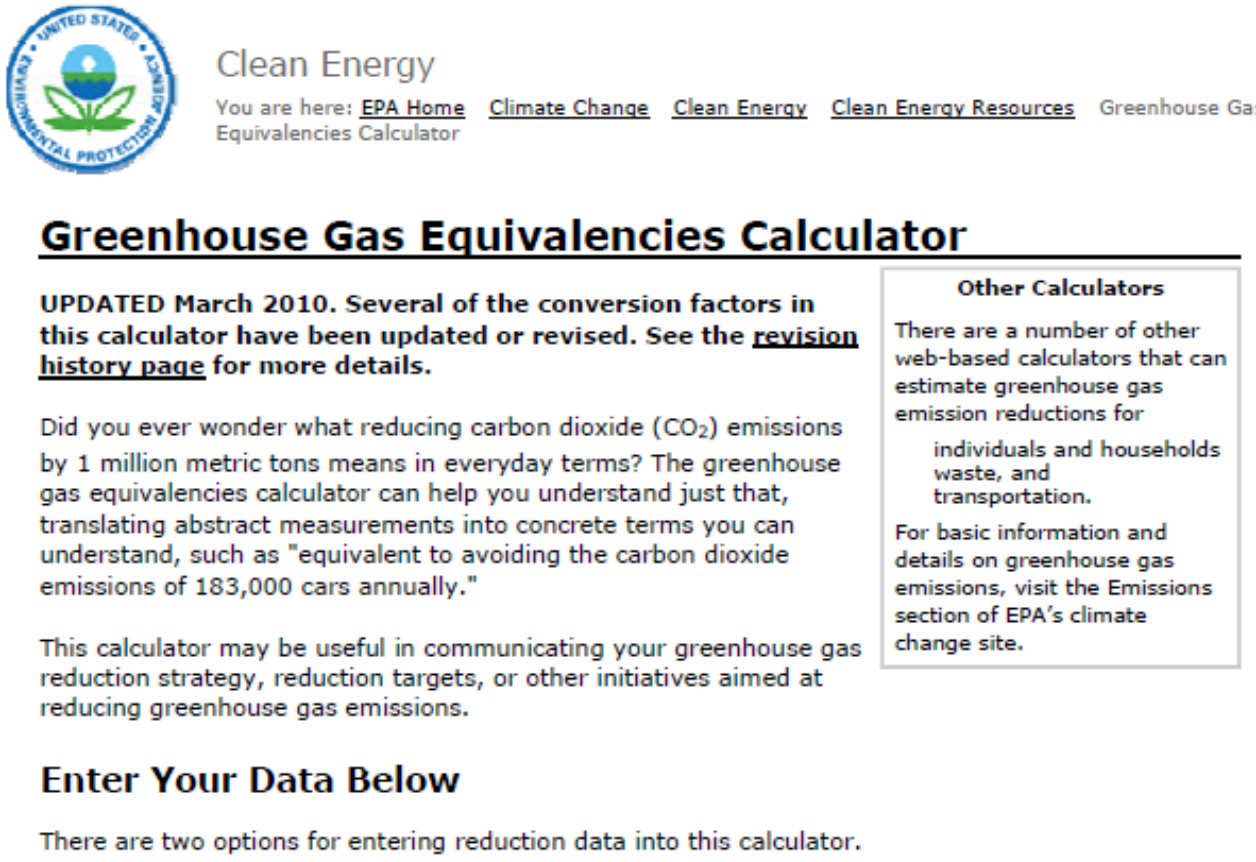
EPA's Simplified GHG Emissions Calculator - continued

- Free download at:
  - http://www.epa.gov/climateleaders/smallbiz/footprint.html
  - Excel-based
- Calculates equivalent Carbon Dioxide emissions
  - By region
- For Direct Combustion Sources
  - Stationary or Mobile Combustion
  - Refrigeration and Air Conditioning
  - Fire Suppression Equipment
  - Gas Waste Streams
- For Indirect Sources
  - Purchased Electricity, Fuels
- For Travel Activities
  - Transportation

Using the EPA Equivalent Tool…

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

- http://www.epa.gov/cleanenergy/energy-resources/calculator.html#results



Clean Energy

You are here: EPA Home Climate Change Clean Energy Clean Energy Resources Greenhouse Gas Equivalencies Calculator

Greenhouse Gas Equivalencies Calculator

UPDATED March 2010. Several of the conversion factors in this calculator have been updated or revised. See the revision history page for more details.

Did you ever wonder what reducing carbon dioxide (CO_2) emissions by 1 million metric tons means in everyday terms? The greenhouse gas equivalencies calculator can help you understand just that, translating abstract measurements into concrete terms you can understand, such as "equivalent to avoiding the carbon dioxide emissions of 183,000 cars annually."

This calculator may be useful in communicating your greenhouse gas reduction strategy, reduction targets, or other initiatives aimed at reducing greenhouse gas emissions.

Other Calculators

There are a number of other web-based calculators that can estimate greenhouse gas emission reductions for

- individuals and households
- waste, and
- transportation.

For basic information and details on greenhouse gas emissions, visit the Emissions section of EPA's climate change site.

Enter Your Data Below

There are two options for entering reduction data into this calculator.

Additional Information

- Please visit FEMPs Greenhouse Gases website for additional resources to help you with your inventory and management of Greenhouse Gases.
  - http://www1.eere.energy.gov/femp/program/greenhousegases.html
- The EPA website is also a good resource for more information about Greenhouse Gas Emissions
  - http://www.epa.gov/climatechange/emissions/index.html

For your Future Needs…

- FEMP's Technology Deployment
  - Industrial Energy Resources and Training
    - http://www1.eere.energy.gov/femp/program/industrial_facilities.html
    - Thomas Wenning, wenningtj@ornl.gov , 865-241-8676
- ITP's BestPractices
  - Technical Publications and Software Tools
    - http://www1.eere.energy.gov/industry/bestpractices/resources.html

Thanks for Attending!

- Slides will be Available
- Training Archived
- Course Evaluation for PDH Certificate

Questions?

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